

## HIERARCHIES OF LIFE

A Proposal for an Educational Film

Stephen Bowlsby

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## CONTENTS

Introduction	1
Format and Audience	2
The Concept of the Hierarchy and its Significance	2
Letters of Support	3
Treatment	4
Rough Script and Allegorical Play	5
Schedule and Budget Summary	17
Market Analysis	18

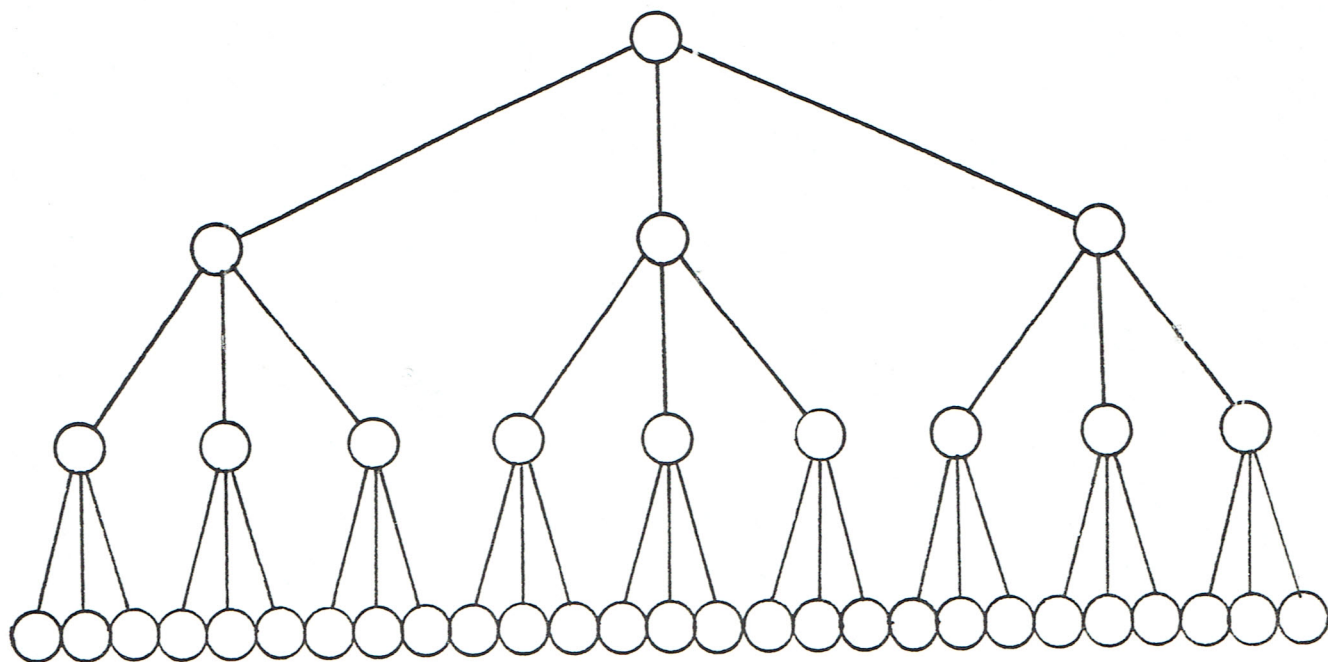


figure 1.

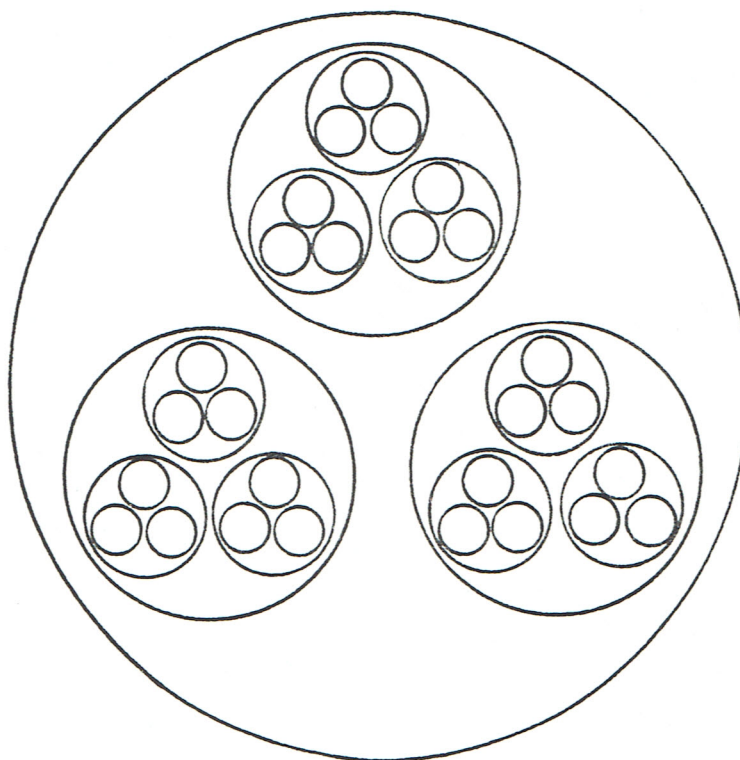


figure 2.

## INTRODUCTION

This is a film about organization. The organization of Life.

It stands on its own, providing an important perspective for the modern understanding of Life and all it entails.

It presents a general pattern into which further specific enquiry fits like a glove - and so it is here proposed as a pilot film for a series that examines biology, ecology, sociology, and psychology in light of a unifying view.

The time is ripe.

(Please note that the length of the film is flexible, as is the choice of experts to interview.)



**FORMAT**                    16mm, color, 30 minutes.

**AUDIENCE**                College and general adult.

The concept introduced in this film marks the shift in emphasis in scientific inquiry in the coming decade. A shift that promises to revolutionize our understanding of Life, and of Man.

## **THE CONCEPT OF THE HIERARCHY AND ITS SIGNIFICANCE**

Look at any complex system of organization - physical, biological, ecological, social, psychological, military, computer - and one thing becomes plain:

The whole is equal to far more than the sum of its parts.

This is most readily recognized in Biology. Here we know a great deal about the parts; but now, to understand further, we must discover the relationships between them.

Figures 1 and 2 illustrate the schematic structure of a simple hierarchy.

Each "sub-whole" has the dual tendency to preserve and assert its individuality as a self-contained whole; and to function as an integrated part of a larger whole.

Towards the apex of the hierarchy, the sub-wholes show increasingly more flexible patterns of activity, while those toward the base are increasingly more stereotyped and specialized. The greater flexibility of the apex results precisely because of this hierarchical organization it has to "draw on."

The application of this model cannot be simply explained here in a few words. Suffice it to say that the importance of the perspective afforded by it is being expressed with accelerating emphasis by the scientists and philosophers of our day.

The new emphasis is a holistic one - it is not enough to break things apart and study the pieces by themselves, for there is no life without the special organization that makes "the whole greater than the sum of its parts."

The time is ripe for this perspective to become widely adopted, particularly by college students; and as the following letters of support indicate, it is being neglected amid the myriad details of individual college courses.

These professors feel the film is important for both the students and the public, and they have consented to be interviewed in it.

(Note: Diane Demille was involved in the initiation of the project and in the writing of the screenplay, but will not be involved in the production of the film itself.)

#### LETTERS OF SUPPORT

see following pages.

THE UNIVERSITY OF BRITISH COLUMBIA  
2075 WESBROOK MALL  
VANCOUVER, B.C., CANADA  
V6T 1W5

HEALTH SCIENCES CENTRE  
Office of the Co-ordinator  
Division of Health Systems  
Instructional Resources Centre Bldg.  
Telephone (604) 228-2258

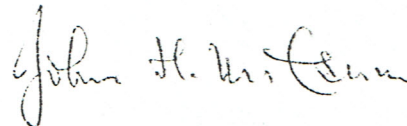
May 9, 1978

re: Proposal for an educational film "Hierarchies of Life"

by: DeMille/Bowlsby

To Whom It May Concern

I have come to know Dianne DeMille through her broad interest in Systems theory, and more particularly through applying it to living hierarchies. I have been very impressed with her approach to preparing the format for an educational film, and feel that the film which can now be produced from it would be very worthwhile for a wide variety of audiences interested in biological systems. I would therefore strongly urge any interested parties to support this endeavor.



John H. Milsum, Sc.D.  
Professor and Director  
Division of Health Systems

JHM/sm



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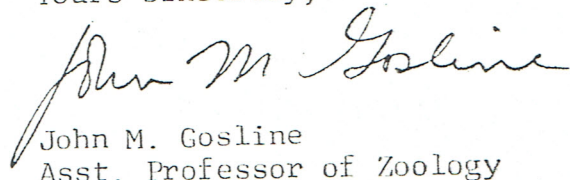
DEPARTMENT OF ZOOLOGY

May 19, 1978

TO WHOM IT MAY CONCERN,

The proposed educational film, "Heirarchies of Life", will be a useful aid that will provide advanced high school or first year undergraduate students in the life sciences with some important insights into the fundamental principles of living systems. Although all teachers try to present their students with basic principles, we often deal with information at a single level of organization and omit a discussion of the relationships between levels of organization. Further, students are usually so busy with details that they have little time to reflect on general principles or on the integration of information. This film should provide an interesting and amusing format for presenting the concept of heirarchial structures, and in so doing it will help the students to recognize many important generalizations about living systems. The film will be an important asset in any introductory course and I strongly recommend that this film be produced.

Yours sincerely,

  
John M. Gosline  
Asst. Professor of Zoology

THE UNIVERSITY OF BRITISH COLUMBIA  
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VANCOUVER, B.C., CANADA  
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DEPARTMENT OF ZOOLOGY

May 16, 1978

To Whom It May Concern

I have examined the outline of the proposed educational film on Hierarchical Systems. This will largely be concerned with the paradigm of hierarchical systems in biology.

Stephen Bowlsby and Dianne Demille obviously know exactly what they want to do, and have a real feel for the subject. They are technically competent and already have contacted the scientists they wish to interview and film.

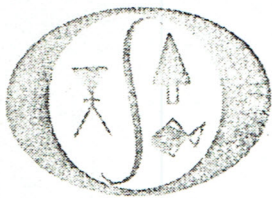
There is no doubt that the topic is timely and the film would have enormous education value. I recommend that every support should be given to this proposal.

Yours sincerely,



Dr. G.G.E. Scudder, Head  
Department of Zoology

GGES:ip



Institute of Animal Resource Ecology  
The University of British Columbia  
2075 Wesbrook Mall  
Vancouver, B.C., Canada V6T 1W5

TEL. (604) 228-2731

16 May 1978

To whom it may concern:

I have read the script for the film "Hierarchies of Life" and find it engrossing, perceptive and relevant. The authors have identified key questions and have responded to them by concentrating on the most substantial work in the field. There is a great need to communicate such ideas to a public audience, and I strongly recommend support for implementing this film.

C. S. Holling  
Professor  
Institute of Resource Ecology and  
Department of Zoology

Research Scholar  
International Institute for  
Applied Systems Analysis

CSH/wec



## TREATMENT

The film will be a mixture of live interviews; graphics and animation; and an allegorical "stage play."

At this point, several professors from the University of British Columbia, Vancouver, Canada, are committed to the film, and are listed in the script. Concerned scientists from other universities could be contacted if necessary.

These interviews (presented without the intrusion of the interviewer) will provide credibility and authority - here are men engaged each in his own specialty, yet each recognizing the impact of this hierarchy model on their work.

Included are:

Dr. Michael Ovenden, Astronomy/Geophysics Dept., U.B.C.  
Dr. John Milsum, Health Care Systems, U.B.C.  
Dr. C.H. Holling, Institute of Animal Resource Ecology  
Dr. Geoffrey Scudder, head of the Zoology Dept., U.B.C.  
Dr. Jack Cowan, Dept. of Theoretical Biology, Univ. of Chicago \*

The easiest way to understand hierarchical organization in the real world is visually. Thus the graphics and animation will be of key importance in creating an indelible impression of this all-pervasive concept. Examples included will be: the organization of the cell, the organs of the human body, the development of the egg cell into a complex new living being (differentiation), the structure of ecosystems, and the interrelation of neural pathways in the brain.

The allegorical stage play, a humorous take-off on Greek mythological plays, helps to sustain interest, ties the progression of ideas together, ensures that it does not become too dry for the general audience, and, again, leaves a more lasting impression.

What follows is the allegorical stage play, together with a brief description of the other parts of the film.

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\* Dr. Jack Cowan's part in the film, a three-way discussion on consciousness with Ovenden and Milsum, has already been filmed. It is the last interview in the film.

HIERARCHIES OF LIFE

Screenplay



FADE IN

ALLEGORICAL PLAY

The background is a black expanse riddled with stars. Barely visible in the foreground is a shiny black box. A voice calls from off-stage.

SUPERIOR

Deus! Deus!

Deus, a god-in-training, pops up from behind the box. He wears a toga.

DEUS

I'm over here!

His Superior enters, a woman in a long, flowing robe. She is stately, graceful and slightly arrogant.

SUPERIOR

Deus, where's that solar system you've been working on?

DEUS

Over here. I keep it in this black box.

SUPERIOR

What? You can't separate it from the rest of the Universe!

DEUS

Oh, don't worry.

(He taps the box.)

It's not real - just for convenience.

SUPERIOR

Well, I've come to give you your assignment. It's time for a real test of your ability. We want you to create Life. You are to populate one of your planets. There.....

(she points)

.....that one looks good - the third one from the sun.

DEUS

What? Create Life? Populate an entire planet? It'll take a miracle!

SUPERIOR

No miracles!

(Pointing a finger at him.)

Any neophyte god can perform miracles. No, you must devise a way of creating stable, living forms using the materials and conditions already present on the planet.

Deus sighs and looks dejected. The superior puts her hand on his shoulder.

## SUPERIOR

Courage, my boy, we are confident that you can do it. Now listen.....

(She looks him in the eye)

.....you've got to lay down a set of ground rules and stick to them; you need a system or else you'll end up with Chaos. Start out simply and work up to something more complex.

## DEUS

But how? How do I organize the raw materials of that turbulent planet into complex, living forms?

## SUPERIOR

Hierarchies, my boy! The oldest game plan in the Universe.

## DEUS

(puzzled)

Hierarchy? What's a hierarchy?

## GRAPHIC MONTAGE

A rapid series of graphics illustrates schematically the structure of hierarchies.

## DR. MICHAEL OVENDEN

describes the characteristics of hierarchical structure and the importance of the paradigm to future scientific research. He refers to a parable that illustrates the efficiency of construction based on the hierarchical plan:

## ANIMATION

### THE PARABLE OF THE TWO WATCHMAKERS

Two watchmakers, Mekhos and Bios, had each devised a different way of manufacturing a watch out of one thousand separate parts. Mekhos assembled his watch bit by bit, at all times an unstable collection of parts in his hand. If he was interrupted in his work, the partially completed watch would fall apart and he would have to start all over again; it took him an unprofitably long time to make a watch. Bios, on the other hand, had a better idea. He would first produce independent, stable sub-assemblies of ten components each. These he then arranged, by tens, into sub-assemblies of a higher order. Lastly, ten of these higher units were put together to form the completed watch. Thus, if Bios were distrubed and had to put down his watch, he would have at most nine operations to perform again. The method of Bios was immensely more efficient than that of Mekhos, and the product was much more resistant to damage. Bios prospered and Mekhos had to close up shop.

### ALLEGORICAL PLAY - SCENE TWO

Deus is hunched over a microscope set up on his black box. Enter ELYSE, a goddess younger than Deus, playing with a blob of clay.

ELYSE

What are you doing?

DEUS

(Looking tired and frustrated, sighs)

Trying to create Life.

ELYSE

Life? Oh, that's easy! Watch this!

She rolls up a piece of clay in her hand and prepares to blow on it.

#### DEUS

No! I can't do it that way. I've got to produce Life using the chemicals of this planet as building blocks.

Elyse peers into the microscope, then looks up at Deus again.

#### ELYSE

(Cynically)

Good luck!

#### DEUS

Well, no, it's not as impossible as it seems. I've already turned some of the little molecules into big molecules. Now, if I could just find some way of getting them organized into.....

(he gestures with his hands to indicate a package)

...into some kind of orderly, self-replicating, uh,...uh, system - Well, once that's done, half the battle's over.

#### ANIMATED SEQUENCE

The parts of the cell, the nucleus, the mitochondrion, the ribosome, the endoplasmic reticulum, etc., are depicted as semi-autonomous sub-units each with particular functions. The complex interrelationship of these parts is illustrated by tracing the production and transport of a single protein from the read-out of the DNA to the lining up of the amino acids to the export of the protein out of the cell. The sequence is augmented by electron micrographs and is accompanied by narration and music.

ALLEGORICAL PLAY - SCENE THREE

Deus is looking into his microscope on top of the black box.  
Enter Elyse.

ELYSE

Deus, you've been working non-stop for  
millenia. How're you doing?

DEUS

I've done it! I've produced stable, self-  
replicating systems - cells!

ELYSE

(Peering into the microscope)

Those?

(She looks at him quizzically)

DEUS

O.K., I know they're small, but they are  
extremely complicated. My superior was  
impressed; she appreciates what a major  
accomplishment they represent. You see, now  
that the basic ground rules have been set up,  
Life itself will play out all the possible  
strategies.

ELYSE

You mean it'll change?

DEUS

Yes, it'll evolve - in response to changes in  
the environment limited by the rules of the  
game.



## ELYSE

What are the rules?

## DEUS

(smiling)

Why don't you observe how life evolves on my planet and see if you can figure it out.

Elyse, looking more thoughtful now, gazes into the microscope for some time. Deus smiles.

## DR. JOHN MILSUM

provides examples of feedback loops within the cells, within the organs, and within the organ systems of the individual. He indicates the intricate control mechanisms that exist throughout the hierarchy of the organism and speculates on the complexity involved in the development of such a system.

## AN EMBRYOLOGIST

describes the development of an embryo as a hierarchy that "branches downward" through time. In this light, he points out the problems facing scientists who are trying to unravel the mystery of how a single cell, the fertilized egg, develops into a complex adult organism.

## SPLIT SCREEN - LIVE ACTION/GRAPHIC DISPLAY

Timelapse photography shows the early stages of development of an embryo, while an animated diagram simultaneously illustrates the sequential changes it is going through as a hierarchy branching through time.

## DR. GEOFFREY SCUDDER

talks about the current state of evolutionary theory, indicating the crucial gaps in the story. Specifically, he suggests that an understanding of the principles that govern the kind of development we have just seen, in the embryo, may be necessary to formulate a complete theory about the evolution of the major groups of organisms.

## GRAPHICS - EVOLUTION

During the latter part of Dr. Scudder's talk, the branching tree of evolution is represented, in a highly stylized fashion, as a flowing progression from the first cells to the Great Reptiles.

## ALLEGORICAL PLAY - SCENE FOUR

The superior enters, approaching Deus at his box.

### SUPERIOR

Well, how's it going?

(She looks into the microscope.)

Good God, what are they?!

### DEUS

Dinosaurs.

(He looks lovingly at a Brontosaurus in his hand.)

### SUPERIOR

Get rid of them!

She exits.



## GRAPHICS - EVOLUTION

The unfolding of the phylogenetic tree continues from the mysterious extinction of the Dinosaurs to the advent of modern birds and mammals.

## STOCK FOOTAGE - WILDLIFE

After a few seconds of shots of wildlife, Deus' voice cuts in:

### DEUS

I hope these make a bigger hit than my Dinosaurs.

## DR. C.S. HOLLING

discusses Systems Ecology, pointing out the merits and the pitfalls of computer simulation and modelling techniques that attempt to understand organization on this level.

## DR. JOHN MILSUM

describes the hierarchical structure of human societies, and the conditions necessary for their stability.

## DR. JACK COWAN

talks about the structure and function of the most awesome hierarchy of all - the human brain. He outlines his model of human consciousness.

## DR. COWAN, DR. MILSUM, AND DR. OVENDEN

in a three-way dialogue, discuss the biological, sociological, and philosophical considerations which have been brought to bear on the problem of the evolution of consciousness. \*

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\* this interview has already been filmed. It is set in the new, futuristic Museum of Man at U.B.C., in front of three large and ancient West Coast Indian totem poles.

ALLEGORICAL PLAY - SCENE FIVE

DEUS

Hey! Come and look at these guys!

Elyse is standing at a blackboard, deep in thought. On the board are words: multi-levelness, sub-assemblies, feedback control, integration. She finally leaves her board to have a look in the microscope.

ELYSE

Hey.....they look like.....What are they?

DEUS

I call them Homo sapiens because they are different from the other mammals. They're aware.

ELYSE

Aware? Aware of what?

DEUS

Well, for one thing, they are aware that they must die.

ELYSE

They don't have to die. You could prevent them from dying.

## DEUS

No, in order for Life to evolve, individuals have to die. It's one of the primary rules of the game.

(Pause)

That's another thing: they are aware that there are rules.....

(looks into the microscope and speaks more slowly)

.....and they're trying to figure out what they are.

## MONTAGE

MUSIC IN.

A rapid series of scenes dissolving from one to the next show diverse people at work and at play: scientists, priests, children, workers, businessmen and women, surgeons, painters, sculptors, and so on. People of all sorts are seen, doing what they do every day. Voices and sounds merge with the music. After several seconds of the montage, the voice of Elyse is heard:

## ELYSE

They'll die before they ever figure it out.

Montage continues with music over for a few more seconds, then cuts to **BLACK**. MUSIC OUT.

## DEUS

I don't know...they're pretty clever.

END.